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PATENT APPLICATION

Attorney Docket No: 10007794-1

IN THE
UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors:	**Chen et al**	**Examiner:**	**Monica Lewis**
Serial No:	**09/846,127**	**Group Art Unit:**	**2822**
Filing Date:	**April 30, 2001**	**Confirmation No:**	**5243**
Title:	**Annealed Tunneling Emmitter**		

COMMISSIONER FOR PATENTS
PO Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL LETTER

Sir:

Transmitted herewith is/are the following in the above-identified application:

(X) Appeal Brief

At any time during the pendency of this application, please charge any fees required or credit any overpayment to Deposit Account **08-2025** pursuant to 37 CFR 1.25. A duplicate copy of this transmittal is enclosed.

HEWLETT-PACKARD COMPANY
Legal Department

Respectfully Submitted,

Chen et al

By: Timothy F. Myers
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Typed Name: **Timothy F. Myers**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of: Chen, Zhizang, et al. Art Unit: 2822
Examiner: Lewis, Monica

Serial Number: 09/846,127
Filed: April 30, 2001
Title: ANNEALED TUNNELLING EMITTER
Date: February ___, 2004

APPEAL BRIEF UNDER 37 CFR §1.192

TO THE ASSISTANT COMMISSIONER FOR PATENTS:

Sir:

This Brief is submitted in triplicate in support of the Appeal in the above-identified application.

1. REAL PARTY IN INTEREST

The real party of interest is Hewlett-Packard Company. The assignee is Hewlett-Packard Development Company, LP, a Texas limited partnership and a wholly owned affiliate of Hewlett-Packard Company.

2. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

3. STATUS OF THE CLAIMS

Claims 1-17 and 21-40 stand finally rejected by the Examiner as noted in the Final Action dated November 21, 2003. Claims 18-20 and 41-71 have been cancelled as drawn to previously non-elected inventions.

4. STATUS OF AMENDMENTS

There have been no amendments filed subsequent to the final rejection.

5. SUMMARY OF THE INVENTION

Applicants' invention concerns the fabrication of a new flat emitter 50 that performs better in many ways over previous designs. Applicants' emitter 50 has an electron supply layer or source 10, a tunneling layer 20 formed on the electron supply layer 10, and a cathode layer 14 formed on the tunneling layer. To achieve the exceptional results of Applicant's emitter 50, the electron supply 10, tunneling layer 20, and cathode layer 14 are subjected to an annealing process (120, 122, see Figs 12A-B). This annealing process increases the supply of electrons 16 tunneled from the electron supply layer 10 to the cathode layer 14. As noted in the declaration filed subsequent to the filing of the application, this annealing process creates a new structure by forming nanohole-sized openings with the cathode layer 14. By having the nanohole-sized openings, the current density (current/area or alternatively emission current) is substantially increased over prior art flat emitters. Using the materials (such as metal cluster dielectrics) and structures (various device thicknesses) disclosed, the emission current could be 10mAmps, 100mAmps, or 1 Amp per square centimeter (page 3, line 16-19). This current density is one, two, or three orders, respectively, greater than that of conventional flat emitter technology. In addition, another observed phenomenon is that of photon emissions 18 in addition to the electron emissions 16. This feature is not found in prior art flat emitter devices. Applicants' new emitter has several applications in memory storage or display devices (see Figs, 3, 6, 7 and 10). Further, due to the increased emission capability, less drive voltage is required allowing for the integration of these flat emitters with conventional IC technology (see Fig. 4).

6. ISSUES

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*[1], in rejecting claims 1-12 and 14 under 35 USC §103(a) over Chuman et al. in view of Hu?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 13, 16, and 17 under 35 USC § 103 over Chuman et al. in view of Hu and Xia?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 15 under 35 USC § 103 over Chuman et al. in view of Hu, Xia and Gibson?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 21-27 under 35 USC § 103 over Chuman et al. in view of Moyer and Hu?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 28, 31, and 33 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Xia?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 29 and 32 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Gibson?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 30 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Suehiro?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 34-40 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Huang et al.?

[1] *In re Lintner*, 458 F.2d 1013, 173 USPQ 560, 562 (CCPA 1972).

7. GROUPING OF THE CLAIMS

Applicants expressly state that the rejected claims do not rise or fall together as a single group. Applicants consider the following groups of claims to be separately patentable for the reasons stated below in the Argument section:

Group	*Claims in Group*
I	Claims 1-4, 8-12, 14, 15, 21, 23, 25-27, 29-33
II	Claims 13, 16-17
III	Claims 5-7, 24, 35
IV	Claims 22, 28, 40
VI	Claims 34, 36-39

8. ARGUMENT

8A. Overview

Applicants are under no illusions that their invention is going to end up in a Nobel Prize for physics. Instead, Applicants invention as claimed covers a relatively simple but elegant concept: providing a new flat emitter design that provides for increased emission, longer lifetimes, integration with conventional integrated circuits, and direct photonic emission. It is Applicants' belief that the Examiner has failed to consider their invention as a whole. Rather than ascertaining whether or not the cited reference teaching would appear to be sufficient for one of ordinary skill in the art to make the combination, the Applicants believe the Examiner is incorrectly using Applicants' claimed invention as a template to combine the various elements found in the cited references.[2] Further, as stated in MPEP 2141.02, the Examiner must consider the claimed invention 'as a whole'. This means that if the insight of the inventors were contrary to the understandings and expectations of the art, the structure effectuating it would not have been obvious to those skilled in the art. Further, the Examiner must consider the prior art in its entirety, including those disclosures that teach away from the Applicants claimed invention.

[2] Id.

These errors by the Examiner have resulted in the failure, particularly in the lack of a reasoned argument as required by MPEP §2142,[3] of the Examiner's obligation to perform the duty of establishing a *prima facie* case of obviousness in making a rejection under 35 USC § 103.

8B. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 1-12 and 14 under 35 USC §103(a) over Chuman et al. in view of Hu?

In Section 3 of the Final Action, the Examiner rejected claims 1-12 and 14 under 35 USC 103(a) as being unpatentable over Chuman in view of Hu. Applicants respectfully traverse this rejection. It is improper to combine Hu with Chuman, as there is no objective reason to make this combination.

As stated in In re Lintner[4] a prima facie case of obviousness requires the PTO to "ascertain whether or not the reference teachings would appear to be sufficient for one of ordinary skill in the relevant art having the references before him to make the proposed substitution, combination or other modification." "To reach a proper conclusion under §103, the decision maker must step backward in time and into the shoes worn by that "person" when the invention was unknown and just before it was made. In light of all the evidence, the decision maker must then determine whether the . . . claimed invention as a whole would have been obvious at that time to that person."[5] Further, "obviousness under 35 USC 103 ((1982) & Supp. III 1985) is a legal issue, the determination of which involves factual inquires into (1) the scope and content of the prior art, (2) the level of ordinary skill in the art, (3) the differences between the claimed invention and the prior art, and (4) any objective evidence of non obviousness, such as long felt

[3] "When an Applicant submits evidence, whether in the specification as originally filed or in response to a rejection, the Examiner must reconsider the patentability of the claimed invention. The decision on patentability must be based upon consideration of all the evidence, including evidence submitted by the Examiner and evidence submitted by the Applicant. A decision to make or maintain a rejection in the face of all the evidence must show that it was based on the totality of the evidence. Facts established by rebuttal evidence must be evaluated along with the facts on which the conclusion of obviousness was reached, not against the conclusion itself. Citing In re Eli Lilly & Co., 902 F.2d 943, 14 USPQ.2d 1741 (Fed Cir. 1990).

[4] 458 F.2d 1013, 173 USPQ 560, 562 (CCPA 1972)

[5] Panduit Corp. v. Dennison Manufacturing Co., 1 USPQ 2d 1593, 1595-96 (Fed. Cir.), cert. Denied, 481 U.S. 1052 (1987).

need, commercial success, failures of others."[6] The Applicants believe the Examiner has failed to perform such a factual inquiry and has inappropriately used Applicants' claimed invention as a template to make the various 103 combinations.

In addition, the Applicants believe that the Examiner has failed to consider Applicants' invention and indeed the references 'as a whole.' As stated by the Federal Circuit, "the claimed invention must be considered as a whole, and the question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination."[7]

Applicants believe that the Examiner may be not be considering all of the objective evidence that has been presented to demonstrate the results created by the invention that have been long sought in the art, but instead is simply looking at how it differs from prior art devices by the inventors' modification of the process of fabrication. However, "it is to be noted that simplicity and hindsight are not proper criteria for resolving the issue of obviousness."[8] "Furthermore, it is well settled that where the claimed invention solves a problem, the discovery of the source of the problem and its solution are considered to be part of the "invention as a whole" under 35 USC 103."[9]

What's more, the Examiner has not considered all that the references teach and instead has chosen to select individual components of the processes without looking at all that is taught, including those limitations that teach away from Applicants' invention. "[P]rior art references before the tribunal must be read as a whole and consideration must be given where the references diverge and teach away from the claimed invention. . . . Moreover, appellants cannot pick and choose among individual parts of assorted prior art references "as a mosaic to recreate a facsimile of the claimed invention."[10] Again, the Examiner has failed to look at Applicants' claimed invention as a whole but merely looked at what was different between the Applicants' claimed invention and the various cited references. Although the Applicants have submitted additional information in

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[6] Allen Archery Inc. v. Browning Manufacturing Co., 2 USPQ.2d 1490, 1493 (Fed. Cir. 1987).
[7] Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 488 (Fed. Cir. 1984)
[8] Ex parte Clapp, 227 USPQ 972, 973 (B.P.A.I. 1985).
[9] Ex parte Hiyamizu, 10USPQ.2d 1393, 1394-95 (BPAI 1988).

support of the assertions made in the specification, the Applicants believe the Examiner has not accorded them proper weight in determining the non-obviousness of the Applicants' claimed invention. "[A]lthough Graham v. John Deere Co., . . . requires that certain factual inquiries, among them the differences between the prior art and the claimed invention, be conducted to support a determination of the issue of obviousness, the actual determination of the issue requires an evaluation in light of the findings in those inquires of the obviousness of the claimed invention as a whole, not merely the differences between the claimed invention and the prior art."[11]

The Examiner in the "Response to Arguments" section of the final action, states that the while the "Applicant argues that the 'annealing process produces unexpected results which as shown prove emission current density at least one order of magnitude larger than that disclosed by previous art made of record.' . . . "Applicant has not disclosed in the claims any of the limitations disclosed above." Applicants respectfully traverse this statement. Applicants have provided dependent claim limitations to the various current density levels attainable and demonstrated by exemplary embodiments of the claimed device. Applicants are under an obligation to disclose how to make and use[12] the invention and have done so. Applicants are not required to provide a theory of operation, nor are the claims required to provide a written description of the invention.[13] While Applicants have claimed their invention in a 'product-by-process' claim format, they have demonstrated that it results in a different structure by virtue of the annealing process to create 'nanohole sized openings' in the cathode emission layer. It is this resulting structure by which novelty and non-obviousness are determined, and which is not disclosed, taught, or suggested by the art made of record. This formation of the nanohole-sized openings allows for various unexpected results (e.g. increased electron current density, photon emission, reliability, etc.). This change in structure was not known to the Applicants at the time of the submission of the Application but was discovered only after careful investigation. Based on the measured unexpected results, Applicants disclosed

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[10] Akzo N.V. v. United States International Trade Commission, 1 USPQ.2d 1241, 1246 (Fed. Cir 1986), cert. Denied, 482 U.S. 909 (1987).

[11] Lear Siegler; Inc. v. Aeroquip Corp., 221 USPQ 1025, 1033 (Fed. Cir. 1984).

[12] 35 USC §112 1st Paragraph

and claimed their invention in terms of the processes used to create the experimental devices. This form of 'product-by-process' claiming was developed by the courts to "in response to the need to enable an Applicant to claim an otherwise patentable product that resists definition by other than the process by which it is made."[14] "It should not be necessary . . . to point out that a patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the "subject matter as a whole" which should always be considered in determining the obviousness of an invention under 35 USC 103."[15] "Moreover, the conception of a new and useful improvement must be considered along with the actual means of achieving it in determining the presence or absence of invention. . . . The discovery of a problem calling for an improvement is often a very essential element in an invention correcting such a problem; and though the problem, once realized, may be solved by use of old and known elements, this does not necessarily negative invention."[16] "The court must be ever alert not to read obviousness into an invention on the basis of the applicant's own statements; that is, we must view the prior art without reading into that art appellant's teachings. . . . The issue, then, is whether the teachings of the prior art would, in and of themselves and without the benefits of appellant's disclosure, make the invention as a whole, obvious."[17] Applicants believe that without the Applicants' disclosure, a person of ordinary skill in the art at the time the invention was made would not have been able to deduce Applicants' claimed invention without the knowledge gleaned from Applicants' disclosure.

In fact, the Applicants believe that Hu reference cited by the Examiner for the process step of "annealing" an emitter, if read as a whole, teaches away from Applicant's claimed invention. "A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it

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[13] See Orthokenetics Inc. v. Safety Travel Chairs Inc., 806 F.2d 1565, 1 USPQ.2d 1081 (Fed. Cir. 1986).
[14] In re Thorpe, 777 F.2d 781, 227 USPQ 964, 966 (Fed. Cir. 1985).
[15] In re Nomiya, 184 USPQ 607, 612 (CCPA 1975).
[16] In re Bisley, 94 USPQ 80, 86-87 (CCPA 1952).
[17] In re Sponnoble, 160 USPQ 237, 243 (CCPA 1969).

suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant."[18]

Hu has several differences from Applicants flat tunneling emitter. Hu discloses (see col. 3, lines 44-60) a tip field emitter and not a flat tunneling emitter. These two emitters are fundamentally structurally and operationally different. Further, Hu discloses a cathode layer disposed over a doped semiconductor layer (see col. 3 lines 1-27) whereas Applicants disclose a cathode layer disposed over a tunneling (dielectric) layer. This difference of structure creates different results in the annealing process.

Hu discloses subjecting his tip emitter to the annealing process to cause the cathode layer (Iridium) to react with the doped semiconductor layer to create Iridium silicide that has the same thickness as the originally deposited Iridium layer. Hu's process continues by noting that any remaining unreacted Iridium 'would need to be stripped off from the tips. . . . by a wet etching process or any other suitable method.' Thus, in Hu, the annealing is just one of many steps of a process to create a hardened tip. The Examiner has selectively pulled the "annealing step" from Hu's process to combine with Applicants' claimed emitter structure. The Examiner has ignored that Hu's overall process is used to remove the remaining Iridium, as Hu is only using the Iridium not as a cathode layer per se but as a metal layer to react with the doped semiconductor layer to form Iridium silicide which hardens the tip to maintain a sharp profile. If Hu's process "as a whole" where followed on Applicants' structure of a flat emitter with a cathode layer disposed on a dielectric, the result would be inoperative. The cathode layer on the dielectric would not react to form a silicide (indeed it appears to wet, thus creating the nanohole-sized openings). Hu's further step of etching to remove the remaining metal layer would remove the cathode layer from the tunneling emitter completely thus making it inoperative. Therefore, combining Hu with Chuman without knowing the details from the Applicants' disclosure of only performing the annealing step on Applicants' structure and not removing the remaining metal would not create Applicants' claimed invention and resulting structure. Alternatively, it could appear that the Examiner is asserting that it would be

[18] In re Gurley, 31 USPQ.2d 1130, 1131 (Fed. Cir 1994).

obvious to try "annealing" based on reading Hu's disclosure. Notwithstanding, "obvious to try" is not a sufficiently discriminatory test.[19]

Perhaps the Examiner feels that the annealing step is minor and thus is ignoring its resulting impact on changing the structure of the device, which results in the increased electron emissions and ability to create photon emissions. However, the Federal Circuit in Continental Can Co. USA v. Monsanto Co.[20] stated, "when differences that may appear technologically minor nonetheless have a practical impact, particularly in a crowded field, the decision-maker must consider the obviousness of the new structure in this light. Such objective indicia as commercial success, or filling an existing need, illuminate the technological and commercial environment of the inventor, and aid in understanding the state of the art at the time the invention was made." The Applicant has provided evidence of increased emissions, photonic emissions, etc. Yet, the Examiner in the "Response to Arguments" has not addressed these additional considerations with a reasoned argument. Indeed, "evidence of secondary considerations may often be the most probative and cogent evidence in the record. It may often establish that an invention appearing to have been obvious in light of the prior art was not. It is to be considered as part of all the evidence, not just when the decision maker remains in doubt after reviewing the art."[21] "The fact that an invention provides results, which would not have been expected by those skilled in the art, is strong evidence in rebuttal of an assertion that the invention would have been obvious.

"However, the burden of showing unexpected results rests on he who asserts them. Thus it is not enough to show that the results are obtained that differ from those attained in the prior art: that difference must be shown to be an unexpected difference. . . . Nor is it enough to show that certain results would not have been expected by those skilled in the art without establishing that those results are actually obtained through one's invention."[22] This showing of unexpected results the Applicants have done in the specification and further by their declaration. It may be that the Examiner is ignoring these considerations because the evidence of the nanohole-sized openings was determined and presented after the Application was filed. Applicants, however, did describe the

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[19] See In re Lindell, 155 USPQ 521, 523 (CCPA 1967).
[20] 20 USPQ.2d 1746, 1752 (Fed. Cir. 1991).
[21] Stratoflex, Inc. v. Aeroquip Corp., 218 USPQ 871, 879 (Fed. Cir. 1983).

extraordinary and unexpected effects of having the nanohole openings within the specification and had and continue to have dependent claims based on these results. These claims are dependent as the emitter (annealed to create the nanohole-sized openings) can be operated at lower emissions to take advantage of longer operational life. Nonetheless, "facts determinable at a later time may serve to evidence nonobviousness as of the time the invention was made. An invention that did achieve "an effect greater" or that produced "unusual or surprising results" could of course be held to have been nonobvious in light of those facts."[23] Applicants have supplied additional material to show the status of the state of the art that appeared to be limited to about 1 mAmp/sq. cm of electron current. It was the Applicants insight of performing an annealing of the flat tunneling emitter and their extensive testing which demonstrated that they had created a device which solved the problem of how to get an order of magnitude or more of current density. Similarly in In re Quartz,[24] the appeal board stated, "[W]hile workers in the art approached, to some extent, a solution of the problem, the problem was not solved until this appellant conceived the fortunate combination of elements which converted these failures into a success. It is somewhat difficult, sometimes, to say just where invention begins, but it frequently happens, as it seem to have happened here, that someone will conceive of a fortunate combination which produces a great advance in the art, which, perchance, seems to be but a small deviation from the practice and prior knowledge of the art. . . . We are of the opinion that the appellant has made an invention and that he should be given a patent therefore."

Finally, if the invention were as obvious as the Examiner asserts, it begs the question, why hadn't others of known skill in the art performed the annealing step to increase the electron emissions by orders of magnitude when that was the problem they were searching to solve?[25] In conclusion, the Examiner has not made a reasoned argument based on Applicants submitted evidence to show that Applicants unexpected results would have been expected by the combination of

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[22] In re Klosak, 173 USPQ 14, 16 (CCPA 1972).

[23] Kansas Jack, Inc. v. Kuhn, 219 USPQ 857, 860 (Fed. Cir. 1983).

[24] 33 USPQ 504, 506 (CCPA 1937).

[25] See Ex parte Franklin, 41 USPQ 43, 43 (Pat. Off. Bd. App. 1938). (If it were obvious to install applicant's device to increase the mileage before overhaul from 30,000 to 60,000 miles, the device would have been used years ago.)

Hu and Chuman without using the Applicants' disclosure as a template to pull the annealing step from Hu to combine with the structure of Chuman.[26] Accordingly, Applicants request that the rejection under 35 USC 103 for claims 1-4, 8-12, and 14 was improper and thus should be withdrawn.

In the previous amendments, Applicants believe that they have demonstrated the non-obviousness of the claimed emitter and that the subjecting of the claimed emitter to an annealing process creates both statistically and significant practical results which were previously unknown to those skilled in the art and therefore not disclosed, taught, or suggested by the art made of record. Further, the Applicants have demonstrated that the physical structure of the product by process emitter is different from that of the cited art (in that the cathode layer has nanohole openings). Dependent claims 5-7 are believed patentable based at least on the patentability of claim 1 from which they depend directly or indirectly. However, Applicants believe that none of the art cited has been able to create an emission current of 10, 100, or 1000 mAmps per square centimeter which is respectively one, two, and three orders of magnitude greater than the 1 mAmp per square centimeter capability previously reported by the art made of record. Accordingly, dependent claims 5-7 are believed separately patentable over the art made of record.

Accordingly, withdrawal of the rejection under 35 USC 103(a) for claims 1-12 and 14 and their allowance is respectfully requested.

8C. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 13, 16, and 17 under 35 USC § 103 over Chuman et al. in view of Hu and Xia?

In Section 4 of the Final Action, the Examiner rejected claims 13, 16, and 17 under 35 USC 103(a) as being unpatentable over Chuman in view of Hu and Xia. Applicants respectfully traverse this rejection for the reasons stated above for

[26] See In re Soni, 34 USPQ.2d 1684, 1687-88 (Fed. Cir. 1995) (Mere improvements in properties does not always suffice to show unexpected results. In our view, however, when an applicant demonstrates substantially improved results, as Soni did here, and states that the results were unexpected, this should suffice to establish unexpected results in the absence of evidence to the contrary. Soni, who owed the PTO a duty of candor, made such a showing here. The PTO has not provided any persuasive basis to question

the combination of Chuman and Hu. In particular for claim 13, it includes the limitation "the emitter of claim 1 disposed on the substrate" and therefore incorporates the limitations of claim 1 and is at least patentable based on the patentability of claim 1 from which it depends. Claim 13 is believed separately patentable as well. Further with regard to claim 13, Xia does not disclose combining the circuitry for operating the emitter and the emitter itself within the same substrate to create an integrated circuit. Therefore, the Examiner has failed to make a prima facia case of obviousness. With regard to claims 16 and 17, Xia does disclose a display device but not one where the emitter and the circuitry for operating the emitter are combined within the same substrate. Withdrawal of the rejection under 35 USC 103(a) for claims 13, 16, and 17 and their allowance is respectfully requested.

8D. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 15 under 35 USC § 103 over Chuman et al. in view of Hu, Xia and Gibson?

In Section 5 of the Final Action, the Examiner rejected claim 15 under 35 USC 103(a) as being unpatentable over Chuman, in view of Hu, Xia, and Gibson. Applicants respectfully traverse this rejection for the reasons stated above for the combination of Chuman and Hu. In particular for claim 15, it includes the limitation "the emitter of claim 1 disposed on the substrate" from claim 14 on which it depends and therefore incorporates the limitations of claim 1 and is at least patentable based on the patentability of claim 1 from which it depends.

Soni's comparative data and assertion that the demonstrated results were unexpected. Thus, we are persuaded that the Board's finding that Soni did not establish unexpected results is clearly erroneous.).

8E. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 21-27 under 35 USC § 103 over Chuman et al. in view of Moyer and Hu?

In Section 6 of the Final Action, the Examiner rejected claims 21-27 under 35 USC 103(a) as being unpatentable over Chuman, Moyer and Hu. Applicants respectfully traverse this rejection for the reasons stated previously for the rejection of claim 1 that further applies to the limitations in claim 21.

With respect to claim 22, Moyer does not disclose, teach, or suggest that the emitter is capable of emitting photons in addition to electron emission. Moyer instead teaches that the electron emitter emits electrons that strike cathodoluminescent material 22 which re-radiates energy as photons (col. 4, lines 17-31. Therefore, it is not the emitter that is emitting photons, as the Applicants are claiming, but a screen structure having cathodoluminescent material that emits the photons. Contrarily, because the Applicants have subjected the emitter to an annealing process that has changed the structure of the cathode surface to have nanohole-sized structures, photons that are created by electron state transitions after tunneling are able to leave the emitter rather than being absorbed in the cathode layer as with conventional tunneling emitters. Accordingly, Claim 22 is believed to be separately patentable over the art made of record.

Claim 24 is believed at least patentable based on the patentability of claim 21 from which it depends. As discussed previously for the rejection of claims 5-7 in this appeal, it is the annealing process that changes the structure of the emitter by creating nanohole openings in the cathode layer which allows for the higher electron density claimed by the Inventors. This annealing process is not disclosed, taught or suggested by the art made of record, including Hu. Hu discloses an annealing process that is used to create a silicide-metal layer. The Applicants' annealing process produces unexpected results which as shown provide emission current density at least one order of magnitude larger than that disclosed by previous art made of record for tunneling emitters. Such a current density allows the claimed emitter to be substituted for field emission tips (Spindt) emitters. Accordingly, claim 24 is believed separately patentable over the art made of record.

8F. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 28, 31, and 33 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Xia?

In Section 7 of the Final Action, the Examiner rejected claims 28 and 31 and 33 under 35 USC 103(a) as being unpatentable over Chuman in view of Moyer, Hu, and Xia.

In regard to claim 28, the Examiner asserts that Chuman discloses "the emitter emits a visible light source (See Fig. 1)." Applicants respectfully traverse this assertion. Chuman does not disclose, teach, or suggest that the emitter is capable of emitting photons in addition to electron emission. Chuman instead teaches that the electron emitter emits electrons (e) which strike cathodoluminescent material 22 which re-radiates energy as photons (see col. 4, lines 17-31. Therefore, it is not the emitter that is emitting photons, such as the Applicants are claiming, but a screen structure having cathodoluminescent material that emits the photons. It is because the Applicants have subjected the emitter to an annealing process that the structure of the cathode surface has changed to have nanohole structures, thereby allowing photons that are created by electron state transitions after tunneling to leave the emitter rather than being absorbed in the cathode layer as with conventional tunneling emitters such as Chuman. Further, none of the references disclose "a lens for focusing the visible light source, wherein the lens is coated with a transparent conducting surface to capture electrons emitted from the emitter." Accordingly, claim 28 is believed separately patentable over the art made of record.

In regard to claim 31 and 33, claims 31 and 33 depend indirectly on claim 21 and are believed at least patentable based on the patentability of claim 21 as discussed above. Removal of the rejection under 35 USC 103(a) and allowance of claims 28, 31, and 33 are respectfully requested.

8G. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 29 and 32 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Gibson?

In Section 8 of the Final Action, the Examiner rejected claims 29 and 32 under 35 USC 103(a) as being unpatentable over Chuman, in view of Moyer, Hu, and Gibson. Applicants respectfully traverse this rejection. Claims 29 and 32 are dependent on claim 21 and include the limitations of claim 21. Therefore claims 29 and 32 are believed patentable based at least on the patentability of claim 21 from which they depend. Removal of the rejection under 35 USC 103(a) and allowance of claim 29 is respectfully requested.

8H. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claim 30 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Suehiro?

In Section 9 of the Final Action, the Examiner rejected claim 30 under 35 USC 103(a) as being unpatentable over Chuman, in view of Moyer, Hu, and Suehiro. Claim 30 depends on claim 21 and is believed patentable based at least on the patentability of claim 21. Removal of the rejection under 35 USC 103(a) and allowance of claim 30 is respectfully requested.

8I. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 34-40 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Huang et al.?

In Section 10 of the Final Action, the Examiner rejected claims 34-40 under 35 USC 103(a) as being unpatentable over Moyer in view of Hu, and Huang. Claim 34 had been amended previously to include the limitation "wherein the emitter has been subjected to an annealing process." As discussed previously, none of the art cited or made of record discloses, teaches, or suggests the

Applicants' claimed invention 'as a whole,' alone or in combination. Moyer is not a tunneling emitter and adding a tunneling layer within the opening does not disclose "a cathode layer disposed on the tunneling layer and portions of the conductive layer." In fact, Moyer teaches away from Applicants' claimed structure because it discloses an emitter structure (see Fig. 4) of not having the cathode layer deposited in the opening in order to produce the non-uniform electric field. Hu discloses an annealing process to create a silicide-metal layer to maintain tip sharpness for a field emission tip emitter. A person of ordinary skill in the art by simply referring to the Moyer, Huang, Hu, and Chuman references would not be able to objectively combine the references to create the overall structure of Applicants' claimed invention in claim 34. Nor would the person of ordinary skill be able to create an emitter that emits photons as Applicants are claiming in claim 40. Moyer discloses using an emitter to emit electrons which strikes a display that has cathodoluminescent material that then converts the electrons to photons. Moyer does not disclose, teach, or suggest emitting photons as Applicants are claiming. By annealing the emitter, the structure changes, in particular the cathode layer forms nanoholes, such that photon emission and increased electron emission are possible.

Claim 35 is deemed patentable based on the patentability of its parent, claim 34, as amended. Further, claim 35 is believed separately patentable. The claimed emission is expressed in terms of current density per area. It would not be obvious to increase the emissions of Chuman, as one could not increase the current density per area by simply making the emitter larger. The Applicants have increased the emission current density by subjecting the emitter to an annealing process that changes the structure of the emitter, thus allowing for higher emissions. Indeed, Chuman shows in its Fig. 2 a maximizing of current density output of about 1×10^{-3} Amps/cm^2 by manipulating the tunneling layer thickness. The Applicants have been able to far exceed this current density by at least one order of magnitude (a factor of 10X) and indeed by even exceeding 2 orders of magnitude ("about 0.1 to about 1.0 Amps/cm^2" as Applicants are claiming). In making the combination, the Examiner does not disclose how one skilled in the art would increase the current density nor does Simmons or Chuman disclose, teach, or suggest a current density greater than 1×10^{-3} Amps/cm^2. By using the annealing process and its ability to respectively alter the structure of the emitter by

lowering the tunneling layer resistance, reducing ohmic contacts, and most importantly, creating nanohole openings in the cathode layer these unexpected results have been obtained. None of these changes in structure have been disclosed, taught, or suggested by the proposed combination. Further evidence of the state of the art in electron emission density is found in Kusunoki on page 1667 (bottom of left column) wherein the emission current to date (8/20/99 when manuscript received) is 50 x 10^{-6} Amps/cm^2. The desire for at least 1 mA/cm^2 is noted. In Fig. 5, Kusunoki only discloses an emission density of up to this 1mA/cm^2 limit, i.e. the same as Chuman. By annealing the emitter, Applicants have significantly and substantially outperformed other flat tunneling emitters created by prior art techniques thus allowing substitution for less reliable field emission tip emitters.

Claim 36 is believed patentable based at least on the patentability of its parent claim, claim 34.

Claims 37-39 are deemed patentable based at least on the patentability of their parent claim 34.

9. Conclusion

The Examiner erred in failing to establish a case of *prima facie* obviousness in rejecting claims 1-17 and 21-40. Applicants respectfully request reversal of these rejections from the Board of Patent Appeals and Interferences, along with timely issuance of a notice of allowance indicating that claims 1-17, and 21-40 are allowed.

Applicants will defer their decision as to whether or not to request oral argument until after receipt of the Examiner's Answer to this Appeal Brief.

Respectfully Submitted,

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APPENDIX

1. (Previously Amended) An emitter, comprising:

an electron supply;

a cathode layer; and

a tunneling layer disposed between the electron supply and the cathode layer wherein the electron supply, cathode layer, and tunneling layer have been subjected to an annealing process.

2. (Original) The emitter of claim 1 wherein the tunneling layer is a metal cluster dielectric.

3. (Original) The emitter of claim 1 wherein the tunneling layer is a metal cluster dielectric selected from the group consisting of TiO_x, TaO_x, WSiN, $TaAlO_xN_y$, $TaAlO_x$ and AlO_xN_y.

4. (Original) The emitter of claim 1 wherein the cathode layer is selected from the group consisting of platinum, gold, molybdenum, tantalum, iridium, ruthenium, chromium, and alloys thereof.

5. (Original) The emitter of claim 1 operable to provide an emission current of greater than 1×10^{-2} Amps per square centimeter.

6. (Original) The emitter of claim 1 operable to provide an emission current of greater than 1×10^{-1} Amps per square centimeter.

7. (Previously Amended) The emitter of claim 1 operable to provide an emission current of greater than 1×10^{0} Amps per square centimeter.

8. (Original) The emitter of claim 1wherein the tunneling layer has a thickness less than about 500 Angstroms.

9. (Original) The emitter of claim 1 wherein the tunneling layer has a thickness less than about 250 Angstroms.

10. (Original) The emitter of claim 1 wherein the tunneling layer has a thickness less than about 100 Angstroms.

11. (Original) The emitter of claim 1 wherein the tunneling layer has a thickness of about 50 Angstroms.

12. (Original) The emitter of claim 1 wherein the tunneling layer has a thickness within the range of about 50 to about 250 Angstroms.

13. (Original) An integrated circuit, comprising:

a substrate;

the emitter of claim 1 disposed on the substrate; and

circuitry for operating the emitter formed on the substrate with the emitter.

14. (Original) An electronic device, comprising:

the emitter of claim 1 capable of emitting energy; and

an anode structure capable of receiving the emitted energy and generating at least a first effect in response to receiving the emitted energy and a second effect in response to not receiving the emitted energy.

15. (Original) The electronic device of claim 14 wherein the electronic device is a mass storage device and the anode structure is a storage medium, the electronic device further comprising a reading circuit for detecting the effect generated on the anode structure.

16. (Original) The electronic device of claim 14 wherein the electronic device is a display device and the anode structure is a display screen that creates a visible effect in response to receiving the emitted energy.

17. (Original) The electronic device of claim 16 wherein the display screen includes one or more phosphors operable for emitting photons in response to receiving the emitted energy.

Claims 18-20 (Cancelled).

21. (Original) An emitter, comprising:

an electron supply layer;

an insulator layer formed on the electron supply layer and having an opening defined within;

a tunneling layer formed on the electron supply layer in the opening; and

a cathode layer formed on the tunneling layer;

wherein the emitter has been subjected to an annealing process to increase the supply of electrons tunneled from the electron supply layer to the cathode layer for energy emission.

22. (Original) The emitter of claim 21 capable of emitting photons in addition to the electron emission.

23. (Original) The emitter of claim 21 wherein the tunneling layer is a metal cluster dielectric.

24. (Original) The emitter of claim 21 wherein the cathode layer has an emission rate greater than about 0.01 Amps per square centimeter.

25. (Original) The emitter of claim 21 wherein the tunneling layer is a metal cluster dielectric selected from the group consisting of TiO_x, TaO_x, WSiN, $TaAlO_xN_y$, $TaAlO_x$ and AlO_xN_y.

26. (Original) The emitter of claim 21 wherein the tunneling layer has a thickness less than 500 Angstroms.

27. (Original) The emitter of claim 21 wherein the tunneling layer has a thickness between about 50 Angstroms and about 250 Angstroms.

28. (Original) A display device, comprising:

an integrated circuit including the emitter of claim 21, wherein the emitter emits a visible light source; and

a lens for focusing the visible light source, wherein the lens is coated with a transparent conducting surface to capture electrons emitted from the emitter.

29. (Original) A storage device, comprising:

an integrated circuit including the emitter of claim 21 wherein the emitter creates an electron beam current; and

a storage medium in close proximity to the emitter, the storage medium having a storage area being in one of a plurality of states to represent the information stored in that storage area;

such that:

an effect is generated when the electron beam current bombards the storage area;

the magnitude of the effect depends on the state of the storage area; and

the information stored in the storage area is read by measuring the magnitude of the effect.

30. (Original) An electronic device, comprising:

an integrated circuit including the emitter of claim 21; and

a focusing device for converging the emissions from the emitter.

31. (Original) A computer system, comprising:

a microprocessor;

the electronic device of claim 30 coupled to the microprocessor; and

memory coupled to the microprocessor, the microprocessor operable of executing instructions from the memory to transfer data between the memory and the electronic device.

32. (Original) The computer system of claim 31 wherein the electronic device is a storage device.

33. (Original) The computer system of claim 31 wherein the electronic device is a display device.

34. (Previously Amended) An emitter, comprising:

an electron supply surface;

an insulator layer formed on the electron supply surface and having a first opening defined within;

an adhesion layer disposed on the insulator layer, the adhesion layer defining a second opening aligned with the first opening;

a conductive layer disposed on adhesion layer and defining a third opening aligned with the first and second openings;

a tunneling layer formed on the electron supply layer within the first, second, and third openings; and

a cathode layer disposed on the tunneling layer and portions of the conductive layer, wherein the portion of the cathode layer on the tunneling layer is an electron-emitting surface wherein the emitter has been subjected to an annealing process.

35. (Original) The emitter of claim 34 wherein the electron emitting surface has an emission rate of about 0.1 to about 1.0 Amps per square centimeter.

36. (Original) The emitter of claim 34, wherein the tunneling layer is a metal cluster dielectric film from the group consisting of TaO_x, WSiN, TiO_x, $TaAlO_xN_y$, $TaAlO_x$, and AlO_xN_y.

37. (Original) The emitter of claim 34, wherein the tunneling layer has a thickness between about 50 Angstroms to about 250 Angstroms.

38. (Original) The emitter of claim 34, wherein the tunneling layer has a thickness of about 100 Angstroms.

39. (Original) The emitter of claim 34, wherein the tunneling layer has a thickness less than about 500 Angstroms.

40. (Original) The emitter of claim 34 wherein the electron-emitting surface also emits photon energy.

Claims 41-71 (Cancelled).

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re application of: Chen, Zhizang, et al. Art Unit: 2822
Examiner: Lewis, Monica

Serial Number: 09/846,127
Filed: April 30, 2001
Title: ANNEALED TUNNELLING EMITTER
Date: February ___, 2004

APPEAL BRIEF UNDER 37 CFR §1.192

TO THE ASSISTANT COMMISSIONER FOR PATENTS:

Sir:

This Brief is submitted in triplicate in support of the Appeal in the above-identified application.

1. REAL PARTY IN INTEREST

The real party of interest is Hewlett-Packard Company. The assignee is Hewlett-Packard Development Company, LP, a Texas limited partnership and a wholly owned affiliate of Hewlett-Packard Company.

2. RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

3. STATUS OF THE CLAIMS

Claims 1-17 and 21-40 stand finally rejected by the Examiner as noted in the Final Action dated November 21, 2003. Claims 18-20 and 41-71 have been cancelled as drawn to previously non-elected inventions.

4. STATUS OF AMENDMENTS

There have been no amendments filed subsequent to the final rejection.

5. SUMMARY OF THE INVENTION

Applicants' invention concerns the fabrication of a new flat emitter 50 that performs better in many ways over previous designs. Applicants' emitter 50 has an electron supply layer or source 10, a tunneling layer 20 formed on the electron supply layer 10, and a cathode layer 14 formed on the tunneling layer. To achieve the exceptional results of Applicant's emitter 50, the electron supply 10, tunneling layer 20, and cathode layer 14 are subjected to an annealing process (120, 122, see Figs 12A-B). This annealing process increases the supply of electrons 16 tunneled from the electron supply layer 10 to the cathode layer 14. As noted in the declaration filed subsequent to the filing of the application, this annealing process creates a new structure by forming nanohole-sized openings with the cathode layer 14. By having the nanohole-sized openings, the current density (current/area or alternatively emission current) is substantially increased over prior art flat emitters. Using the materials (such as metal cluster dielectrics) and structures (various device thicknesses) disclosed, the emission current could be 10mAmps, 100mAmps, or 1 Amp per square centimeter (page 3, line 16-19). This current density is one, two, or three orders, respectively, greater than that of conventional flat emitter technology. In addition, another observed phenomenon is that of photon emissions 18 in addition to the electron emissions 16. This feature is not found in prior art flat emitter devices. Applicants' new emitter has several applications in memory storage or display devices (see Figs, 3, 6, 7 and 10). Further, due to the increased emission capability, less drive voltage is required allowing for the integration of these flat emitters with conventional IC technology (see Fig. 4).

6. ISSUES

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*[1], in rejecting claims 1-12 and 14 under 35 USC §103(a) over Chuman et al. in view of Hu?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 13, 16, and 17 under 35 USC § 103 over Chuman et al. in view of Hu and Xia?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 15 under 35 USC § 103 over Chuman et al. in view of Hu, Xia and Gibson?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 21-27 under 35 USC § 103 over Chuman et al. in view of Moyer and Hu?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 28, 31, and 33 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Xia?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 29 and 32 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Gibson?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 30 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Suehiro?

- Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 34-40 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Huang et al.?

[1] *In re Lintner*, 458 F.2d 1013, 173 USPQ 560, 562 (CCPA 1972).

7. GROUPING OF THE CLAIMS

Applicants expressly state that the rejected claims do not rise or fall together as a single group. Applicants consider the following groups of claims to be separately patentable for the reasons stated below in the Argument section:

Group	*Claims in Group*
I	Claims 1-4, 8-12, 14, 15, 21, 23, 25-27, 29-33
II	Claims 13, 16-17
III	Claims 5-7, 24, 35
IV	Claims 22, 28, 40
VI	Claims 34, 36-39

8. ARGUMENT

8A. Overview

Applicants are under no illusions that their invention is going to end up in a Nobel Prize for physics. Instead, Applicants invention as claimed covers a relatively simple but elegant concept: providing a new flat emitter design that provides for increased emission, longer lifetimes, integration with conventional integrated circuits, and direct photonic emission. It is Applicants' belief that the Examiner has failed to consider their invention as a whole. Rather than ascertaining whether or not the cited reference teaching would appear to be sufficient for one of ordinary skill in the art to make the combination, the Applicants believe the Examiner is incorrectly using Applicants' claimed invention as a template to combine the various elements found in the cited references.[2] Further, as stated in MPEP 2141.02, the Examiner must consider the claimed invention 'as a whole'. This means that if the insight of the inventors were contrary to the understandings and expectations of the art, the structure effectuating it would not have been obvious to those skilled in the art. Further, the Examiner must consider the prior art in its entirety, including those disclosures that teach away from the Applicants claimed invention.

[2] Id.

These errors by the Examiner have resulted in the failure, particularly in the lack of a reasoned argument as required by MPEP §2142,[3] of the Examiner's obligation to perform the duty of establishing a *prima facie* case of obviousness in making a rejection under 35 USC § 103.

8B. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 1-12 and 14 under 35 USC §103(a) over Chuman et al. in view of Hu?

In Section 3 of the Final Action, the Examiner rejected claims 1-12 and 14 under 35 USC 103(a) as being unpatentable over Chuman in view of Hu. Applicants respectfully traverse this rejection. It is improper to combine Hu with Chuman, as there is no objective reason to make this combination.

As stated in In re Lintner[4] a prima facie case of obviousness requires the PTO to "ascertain whether or not the reference teachings would appear to be sufficient for one of ordinary skill in the relevant art having the references before him to make the proposed substitution, combination or other modification." "To reach a proper conclusion under §103, the decision maker must step backward in time and into the shoes worn by that "person" when the invention was unknown and just before it was made. In light of all the evidence, the decision maker must then determine whether the . . . claimed invention as a whole would have been obvious at that time to that person."[5] Further, "obviousness under 35 USC 103 ((1982) & Supp. III 1985) is a legal issue, the determination of which involves factual inquires into (1) the scope and content of the prior art, (2) the level of ordinary skill in the art, (3) the differences between the claimed invention and the prior art, and (4) any objective evidence of non obviousness, such as long felt

[3] "When an Applicant submits evidence, whether in the specification as originally filed or in response to a rejection, the Examiner must reconsider the patentability of the claimed invention. The decision on patentability must be based upon consideration of all the evidence, including evidence submitted by the Examiner and evidence submitted by the Applicant. A decision to make or maintain a rejection in the face of all the evidence must show that it was based on the totality of the evidence. Facts established by rebuttal evidence must be evaluated along with the facts on which the conclusion of obviousness was reached, not against the conclusion itself. Citing In re Eli Lilly & Co. , 902 F.2d 943, 14 USPQ.2d 1741 (Fed Cir. 1990).

[4] 458 F.2d 1013, 173 USPQ 560, 562 (CCPA 1972)

[5] Panduit Corp. v. Dennison Manufacturing Co., 1 USPQ 2d 1593, 1595-96 (Fed. Cir.), cert. Denied, 481 U.S. 1052 (1987).

need, commercial success, failures of others."[6] The Applicants believe the Examiner has failed to perform such a factual inquiry and has inappropriately used Applicants' claimed invention as a template to make the various 103 combinations.

In addition, the Applicants believe that the Examiner has failed to consider Applicants' invention and indeed the references 'as a whole.' As stated by the Federal Circuit, "the claimed invention must be considered as a whole, and the question is whether there is something in the prior art as a whole to suggest the desirability, and thus the obviousness, of making the combination."[7]

Applicants believe that the Examiner may be not be considering all of the objective evidence that has been presented to demonstrate the results created by the invention that have been long sought in the art, but instead is simply looking at how it differs from prior art devices by the inventors' modification of the process of fabrication. However, "it is to be noted that simplicity and hindsight are not proper criteria for resolving the issue of obviousness."[8] "Furthermore, it is well settled that where the claimed invention solves a problem, the discovery of the source of the problem and its solution are considered to be part of the "invention as a whole" under 35 USC 103."[9]

What's more, the Examiner has not considered all that the references teach and instead has chosen to select individual components of the processes without looking at all that is taught, including those limitations that teach away from Applicants' invention. "[P]rior art references before the tribunal must be read as a whole and consideration must be given where the references diverge and teach away from the claimed invention. . . . Moreover, appellants cannot pick and choose among individual parts of assorted prior art references "as a mosaic to recreate a facsimile of the claimed invention."[10] Again, the Examiner has failed to look at Applicants' claimed invention as a whole but merely looked at what was different between the Applicants' claimed invention and the various cited references. Although the Applicants have submitted additional information in

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[6] Allen Archery Inc. v. Browning Manufacturing Co., 2 USPQ.2d 1490, 1493 (Fed. Cir. 1987).
[7] Lindemann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 221 USPQ 481, 488 (Fed. Cir. 1984)
[8] Ex parte Clapp, 227 USPQ 972, 973 (B.P.A.I. 1985).
[9] Ex parte Hiyamizu, 10USPQ.2d 1393, 1394-95 (BPAI 1988).

support of the assertions made in the specification, the Applicants believe the Examiner has not accorded them proper weight in determining the non-obviousness of the Applicants' claimed invention. "[A]lthough Graham v. John Deere Co., . . . requires that certain factual inquiries, among them the differences between the prior art and the claimed invention, be conducted to support a determination of the issue of obviousness, the actual determination of the issue requires an evaluation in light of the findings in those inquires of the obviousness of the claimed invention as a whole, not merely the differences between the claimed invention and the prior art."[11]

The Examiner in the "Response to Arguments" section of the final action, states that the while the "Applicant argues that the 'annealing process produces unexpected results which as shown prove emission current density at least one order of magnitude larger than that disclosed by previous art made of record.' . . . "Applicant has not disclosed in the claims any of the limitations disclosed above." Applicants respectfully traverse this statement. Applicants have provided dependent claim limitations to the various current density levels attainable and demonstrated by exemplary embodiments of the claimed device. Applicants are under an obligation to disclose how to make and use[12] the invention and have done so. Applicants are not required to provide a theory of operation, nor are the claims required to provide a written description of the invention.[13] While Applicants have claimed their invention in a 'product-by-process' claim format, they have demonstrated that it results in a different structure by virtue of the annealing process to create 'nanohole sized openings' in the cathode emission layer. It is this resulting structure by which novelty and non-obviousness are determined, and which is not disclosed, taught, or suggested by the art made of record. This formation of the nanohole-sized openings allows for various unexpected results (e.g. increased electron current density, photon emission, reliability, etc.). This change in structure was not known to the Applicants at the time of the submission of the Application but was discovered only after careful investigation. Based on the measured unexpected results, Applicants disclosed

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[10] Akzo N.V. v. United States International Trade Commission, 1 USPQ.2d 1241, 1246 (Fed. Cir 1986), cert. Denied, 482 U.S. 909 (1987).

[11] Lear Siegler; Inc. v. Aeroquip Corp., 221 USPQ 1025, 1033 (Fed. Cir. 1984).

[12] 35 USC §112 1st Paragraph

and claimed their invention in terms of the processes used to create the experimental devices. This form of 'product-by-process' claiming was developed by the courts to "in response to the need to enable an Applicant to claim an otherwise patentable product that resists definition by other than the process by which it is made."[14] "It should not be necessary . . . to point out that a patentable invention may lie in the discovery of the source of a problem even though the remedy may be obvious once the source of the problem is identified. This is part of the "subject matter as a whole" which should always be considered in determining the obviousness of an invention under 35 USC 103."[15] "Moreover, the conception of a new and useful improvement must be considered along with the actual means of achieving it in determining the presence or absence of invention. . . . The discovery of a problem calling for an improvement is often a very essential element in an invention correcting such a problem; and though the problem, once realized, may be solved by use of old and known elements, this does not necessarily negative invention."[16] "The court must be ever alert not to read obviousness into an invention on the basis of the applicant's own statements; that is, we must view the prior art without reading into that art appellant's teachings. . . . The issue, then, is whether the teachings of the prior art would, in and of themselves and without the benefits of appellant's disclosure, make the invention as a whole, obvious."[17] Applicants believe that without the Applicants' disclosure, a person of ordinary skill in the art at the time the invention was made would not have been able to deduce Applicants' claimed invention without the knowledge gleaned from Applicants' disclosure.

In fact, the Applicants believe that Hu reference cited by the Examiner for the process step of "annealing" an emitter, if read as a whole, teaches away from Applicant's claimed invention. "A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant. The degree of teaching away will of course depend on the particular facts; in general, a reference will teach away if it

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[13] See Orthokenetics Inc. v. Safety Travel Chairs Inc., 806 F.2d 1565, 1 USPQ.2d 1081 (Fed. Cir. 1986).
[14] In re Thorpe, 777 F.2d 781, 227 USPQ 964, 966 (Fed. Cir. 1985).
[15] In re Nomiya, 184 USPQ 607, 612 (CCPA 1975).
[16] In re Bisley, 94 USPQ 80, 86-87 (CCPA 1952).
[17] In re Sponnoble, 160 USPQ 237, 243 (CCPA 1969).

suggests that the line of development flowing from the reference's disclosure is unlikely to be productive of the result sought by the applicant."[18]

Hu has several differences from Applicants flat tunneling emitter. Hu discloses (see col. 3, lines 44-60) a tip field emitter and not a flat tunneling emitter. These two emitters are fundamentally structurally and operationally different. Further, Hu discloses a cathode layer disposed over a doped semiconductor layer (see col. 3 lines 1-27) whereas Applicants disclose a cathode layer disposed over a tunneling (dielectric) layer. This difference of structure creates different results in the annealing process.

Hu discloses subjecting his tip emitter to the annealing process to cause the cathode layer (Iridium) to react with the doped semiconductor layer to create Iridium silicide that has the same thickness as the originally deposited Iridium layer. Hu's process continues by noting that any remaining unreacted Iridium 'would need to be stripped off from the tips. . . . by a wet etching process or any other suitable method.' Thus, in Hu, the annealing is just one of many steps of a process to create a hardened tip. The Examiner has selectively pulled the "annealing step" from Hu's process to combine with Applicants' claimed emitter structure. The Examiner has ignored that Hu's overall process is used to remove the remaining Iridium, as Hu is only using the Iridium not as a cathode layer per se but as a metal layer to react with the doped semiconductor layer to form Iridium silicide which hardens the tip to maintain a sharp profile. If Hu's process "as a whole" where followed on Applicants' structure of a flat emitter with a cathode layer disposed on a dielectric, the result would be inoperative. The cathode layer on the dielectric would not react to form a silicide (indeed it appears to wet, thus creating the nanohole-sized openings). Hu's further step of etching to remove the remaining metal layer would remove the cathode layer from the tunneling emitter completely thus making it inoperative. Therefore, combining Hu with Chuman without knowing the details from the Applicants' disclosure of only performing the annealing step on Applicants' structure and not removing the remaining metal would not create Applicants' claimed invention and resulting structure. Alternatively, it could appear that the Examiner is asserting that it would be

[18] In re Gurley, 31 USPQ.2d 1130, 1131 (Fed. Cir 1994).

obvious to try "annealing" based on reading Hu's disclosure. Notwithstanding, "obvious to try" is not a sufficiently discriminatory test.[19]

Perhaps the Examiner feels that the annealing step is minor and thus is ignoring its resulting impact on changing the structure of the device, which results in the increased electron emissions and ability to create photon emissions. However, the Federal Circuit in Continental Can Co. USA v. Monsanto Co.[20] stated, "when differences that may appear technologically minor nonetheless have a practical impact, particularly in a crowded field, the decision-maker must consider the obviousness of the new structure in this light. Such objective indicia as commercial success, or filling an existing need, illuminate the technological and commercial environment of the inventor, and aid in understanding the state of the art at the time the invention was made." The Applicant has provided evidence of increased emissions, photonic emissions, etc. Yet, the Examiner in the "Response to Arguments" has not addressed these additional considerations with a reasoned argument. Indeed, "evidence of secondary considerations may often be the most probative and cogent evidence in the record. It may often establish that an invention appearing to have been obvious in light of the prior art was not. It is to be considered as part of all the evidence, not just when the decision maker remains in doubt after reviewing the art."[21] "The fact that an invention provides results, which would not have been expected by those skilled in the art, is strong evidence in rebuttal of an assertion that the invention would have been obvious.

"However, the burden of showing unexpected results rests on he who asserts them. Thus it is not enough to show that the results are obtained that differ from those attained in the prior art: that difference must be shown to be an unexpected difference. . . . Nor is it enough to show that certain results would not have been expected by those skilled in the art without establishing that those results are actually obtained through one's invention."[22] This showing of unexpected results the Applicants have done in the specification and further by their declaration. It may be that the Examiner is ignoring these considerations because the evidence of the nanohole-sized openings was determined and presented after the Application was filed. Applicants, however, did describe the

[19] See In re Lindell, 155 USPQ 521, 523 (CCPA 1967).
[20] 20 USPQ.2d 1746, 1752 (Fed. Cir. 1991).
[21] Stratoflex, Inc. v. Aeroquip Corp., 218 USPQ 871, 879 (Fed. Cir. 1983).

extraordinary and unexpected effects of having the nanohole openings within the specification and had and continue to have dependent claims based on these results. These claims are dependent as the emitter (annealed to create the nanohole-sized openings) can be operated at lower emissions to take advantage of longer operational life. Nonetheless, "facts determinable at a later time may serve to evidence nonobviousness as of the time the invention was made. An invention that did achieve "an effect greater" or that produced "unusual or surprising results" could of course be held to have been nonobvious in light of those facts."[23] Applicants have supplied additional material to show the status of the state of the art that appeared to be limited to about 1 mAmp/sq. cm of electron current. It was the Applicants insight of performing an annealing of the flat tunneling emitter and their extensive testing which demonstrated that they had created a device which solved the problem of how to get an order of magnitude or more of current density. Similarly in In re Quartz,[24] the appeal board stated, "[W]hile workers in the art approached, to some extent, a solution of the problem, the problem was not solved until this appellant conceived the fortunate combination of elements which converted these failures into a success. It is somewhat difficult, sometimes, to say just where invention begins, but it frequently happens, as it seem to have happened here, that someone will conceive of a fortunate combination which produces a great advance in the art, which, perchance, seems to be but a small deviation from the practice and prior knowledge of the art. . . . We are of the opinion that the appellant has made an invention and that he should be given a patent therefore."

Finally, if the invention were as obvious as the Examiner asserts, it begs the question, why hadn't others of known skill in the art performed the annealing step to increase the electron emissions by orders of magnitude when that was the problem they were searching to solve?[25] In conclusion, the Examiner has not made a reasoned argument based on Applicants submitted evidence to show that Applicants unexpected results would have been expected by the combination of

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[22] In re Klosak, 173 USPQ 14, 16 (CCPA 1972).

[23] Kansas Jack, Inc. v. Kuhn, 219 USPQ 857, 860 (Fed. Cir. 1983).

[24] 33 USPQ 504, 506 (CCPA 1937).

[25] See Ex parte Franklin, 41 USPQ 43, 43 (Pat. Off. Bd. App. 1938). (If it were obvious to install applicant's device to increase the mileage before overhaul from 30,000 to 60,000 miles, the device would have been used years ago.)

Hu and Chuman without using the Applicants' disclosure as a template to pull the annealing step from Hu to combine with the structure of Chuman.[26] Accordingly, Applicants request that the rejection under 35 USC 103 for claims 1-4, 8-12, and 14 was improper and thus should be withdrawn.

In the previous amendments, Applicants believe that they have demonstrated the non-obviousness of the claimed emitter and that the subjecting of the claimed emitter to an annealing process creates both statistically and significant practical results which were previously unknown to those skilled in the art and therefore not disclosed, taught, or suggested by the art made of record. Further, the Applicants have demonstrated that the physical structure of the product by process emitter is different from that of the cited art (in that the cathode layer has nanohole openings). Dependent claims 5-7 are believed patentable based at least on the patentability of claim 1 from which they depend directly or indirectly. However, Applicants believe that none of the art cited has been able to create an emission current of 10, 100, or 1000 mAmps per square centimeter which is respectively one, two, and three orders of magnitude greater than the 1 mAmp per square centimeter capability previously reported by the art made of record. Accordingly, dependent claims 5-7 are believed separately patentable over the art made of record.

Accordingly, withdrawal of the rejection under 35 USC 103(a) for claims 1-12 and 14 and their allowance is respectfully requested.

8C. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 13, 16, and 17 under 35 USC § 103 over Chuman et al. in view of Hu and Xia?

In Section 4 of the Final Action, the Examiner rejected claims 13, 16, and 17 under 35 USC 103(a) as being unpatentable over Chuman in view of Hu and Xia. Applicants respectfully traverse this rejection for the reasons stated above for

[26] See In re Soni, 34 USPQ.2d 1684, 1687-88 (Fed. Cir. 1995) (Mere improvements in properties does not always suffice to show unexpected results. In our view, however, when an applicant demonstrates substantially improved results, as Soni did here, and states that the results were unexpected, this should suffice to establish unexpected results in the absence of evidence to the contrary. Soni, who owed the PTO a duty of candor, made such a showing here. The PTO has not provided any persuasive basis to question

the combination of Chuman and Hu. In particular for claim 13, it includes the limitation "the emitter of claim 1 disposed on the substrate" and therefore incorporates the limitations of claim 1 and is at least patentable based on the patentability of claim 1 from which it depends. Claim 13 is believed separately patentable as well. Further with regard to claim 13, Xia does not disclose combining the circuitry for operating the emitter and the emitter itself within the same substrate to create an integrated circuit. Therefore, the Examiner has failed to make a prima facia case of obviousness. With regard to claims 16 and 17, Xia does disclose a display device but not one where the emitter and the circuitry for operating the emitter are combined within the same substrate. Withdrawal of the rejection under 35 USC 103(a) for claims 13, 16, and 17 and their allowance is respectfully requested.

8D. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 15 under 35 USC § 103 over Chuman et al. in view of Hu, Xia and Gibson?

In Section 5 of the Final Action, the Examiner rejected claim 15 under 35 USC 103(a) as being unpatentable over Chuman, in view of Hu, Xia, and Gibson. Applicants respectfully traverse this rejection for the reasons stated above for the combination of Chuman and Hu. In particular for claim 15, it includes the limitation "the emitter of claim 1 disposed on the substrate" from claim 14 on which it depends and therefore incorporates the limitations of claim 1 and is at least patentable based on the patentability of claim 1 from which it depends.

Soni's comparative data and assertion that the demonstrated results were unexpected. Thus, we are persuaded that the Board's finding that Soni did not establish unexpected results is clearly erroneous.).

8E. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 21-27 under 35 USC § 103 over Chuman et al. in view of Moyer and Hu?

In Section 6 of the Final Action, the Examiner rejected claims 21-27 under 35 USC 103(a) as being unpatentable over Chuman, Moyer and Hu. Applicants respectfully traverse this rejection for the reasons stated previously for the rejection of claim 1 that further applies to the limitations in claim 21.

With respect to claim 22, Moyer does not disclose, teach, or suggest that the emitter is capable of emitting photons in addition to electron emission. Moyer instead teaches that the electron emitter emits electrons that strike cathodoluminescent material 22 which re-radiates energy as photons (col. 4, lines 17-31. Therefore, it is not the emitter that is emitting photons, as the Applicants are claiming, but a screen structure having cathodoluminescent material that emits the photons. Contrarily, because the Applicants have subjected the emitter to an annealing process that has changed the structure of the cathode surface to have nanohole-sized structures, photons that are created by electron state transitions after tunneling are able to leave the emitter rather than being absorbed in the cathode layer as with conventional tunneling emitters. Accordingly, Claim 22 is believed to be separately patentable over the art made of record.

Claim 24 is believed at least patentable based on the patentability of claim 21 from which it depends. As discussed previously for the rejection of claims 5-7 in this appeal, it is the annealing process that changes the structure of the emitter by creating nanohole openings in the cathode layer which allows for the higher electron density claimed by the Inventors. This annealing process is not disclosed, taught or suggested by the art made of record, including Hu. Hu discloses an annealing process that is used to create a silicide-metal layer. The Applicants' annealing process produces unexpected results which as shown provide emission current density at least one order of magnitude larger than that disclosed by previous art made of record for tunneling emitters. Such a current density allows the claimed emitter to be substituted for field emission tips (Spindt) emitters. Accordingly, claim 24 is believed separately patentable over the art made of record.

8F. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 28, 31, and 33 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Xia?

In Section 7 of the Final Action, the Examiner rejected claims 28 and 31 and 33 under 35 USC 103(a) as being unpatentable over Chuman in view of Moyer, Hu, and Xia.

In regard to claim 28, the Examiner asserts that Chuman discloses "the emitter emits a visible light source (See Fig. 1)." Applicants respectfully traverse this assertion. Chuman does not disclose, teach, or suggest that the emitter is capable of emitting photons in addition to electron emission. Chuman instead teaches that the electron emitter emits electrons (e) which strike cathodoluminescent material 22 which re-radiates energy as photons (see col. 4, lines 17-31. Therefore, it is not the emitter that is emitting photons, such as the Applicants are claiming, but a screen structure having cathodoluminescent material that emits the photons. It is because the Applicants have subjected the emitter to an annealing process that the structure of the cathode surface has changed to have nanohole structures, thereby allowing photons that are created by electron state transitions after tunneling to leave the emitter rather than being absorbed in the cathode layer as with conventional tunneling emitters such as Chuman. Further, none of the references disclose "a lens for focusing the visible light source, wherein the lens is coated with a transparent conducting surface to capture electrons emitted from the emitter." Accordingly, claim 28 is believed separately patentable over the art made of record.

In regard to claim 31 and 33, claims 31 and 33 depend indirectly on claim 21 and are believed at least patentable based on the patentability of claim 21 as discussed above. Removal of the rejection under 35 USC 103(a) and allowance of claims 28, 31, and 33 are respectfully requested.

8G. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 29 and 32 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Gibson?

In Section 8 of the Final Action, the Examiner rejected claims 29 and 32 under 35 USC 103(a) as being unpatentable over Chuman, in view of Moyer, Hu, and Gibson. Applicants respectfully traverse this rejection. Claims 29 and 32 are dependent on claim 21 and include the limitations of claim 21. Therefore claims 29 and 32 are believed patentable based at least on the patentability of claim 21 from which they depend. Removal of the rejection under 35 USC 103(a) and allowance of claim 29 is respectfully requested.

8H. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claim 30 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Suehiro?

In Section 9 of the Final Action, the Examiner rejected claim 30 under 35 USC 103(a) as being unpatentable over Chuman, in view of Moyer, Hu, and Suehiro. Claim 30 depends on claim 21 and is believed patentable based at least on the patentability of claim 21. Removal of the rejection under 35 USC 103(a) and allowance of claim 30 is respectfully requested.

8I. Did the Examiner properly establish a case of *prima facie* obviousness, as required by *In re Lintner*, in rejecting claims 34-40 under 35 USC § 103 over Chuman et al. in view of Moyer, Hu and Huang et al.?

In Section 10 of the Final Action, the Examiner rejected claims 34-40 under 35 USC 103(a) as being unpatentable over Moyer in view of Hu, and Huang. Claim 34 had been amended previously to include the limitation "wherein the emitter has been subjected to an annealing process." As discussed previously, none of the art cited or made of record discloses, teaches, or suggests the

Applicants' claimed invention 'as a whole,' alone or in combination. Moyer is not a tunneling emitter and adding a tunneling layer within the opening does not disclose "a cathode layer disposed on the tunneling layer and portions of the conductive layer." In fact, Moyer teaches away from Applicants' claimed structure because it discloses an emitter structure (see Fig. 4) of not having the cathode layer deposited in the opening in order to produce the non-uniform electric field. Hu discloses an annealing process to create a silicide-metal layer to maintain tip sharpness for a field emission tip emitter. A person of ordinary skill in the art by simply referring to the Moyer, Huang, Hu, and Chuman references would not be able to objectively combine the references to create the overall structure of Applicants' claimed invention in claim 34. Nor would the person of ordinary skill be able to create an emitter that emits photons as Applicants are claiming in claim 40. Moyer discloses using an emitter to emit electrons which strikes a display that has cathodoluminescent material that then converts the electrons to photons. Moyer does not disclose, teach, or suggest emitting photons as Applicants are claiming. By annealing the emitter, the structure changes, in particular the cathode layer forms nanoholes, such that photon emission and increased electron emission are possible.

Claim 35 is deemed patentable based on the patentability of its parent, claim 34, as amended. Further, claim 35 is believed separately patentable. The claimed emission is expressed in terms of current density per area. It would not be obvious to increase the emissions of Chuman, as one could not increase the current density per area by simply making the emitter larger. The Applicants have increased the emission current density by subjecting the emitter to an annealing process that changes the structure of the emitter, thus allowing for higher emissions. Indeed, Chuman shows in its Fig. 2 a maximizing of current density output of about 1×10^{-3} Amps/cm^2 by manipulating the tunneling layer thickness. The Applicants have been able to far exceed this current density by at least one order of magnitude (a factor of 10X) and indeed by even exceeding 2 orders of magnitude ("about 0.1 to about 1.0 Amps/cm^2" as Applicants are claiming). In making the combination, the Examiner does not disclose how one skilled in the art would increase the current density nor does Simmons or Chuman disclose, teach, or suggest a current density greater than 1×10^{-3} Amps/cm^2. By using the annealing process and its ability to respectively alter the structure of the emitter by

lowering the tunneling layer resistance, reducing ohmic contacts, and most importantly, creating nanohole openings in the cathode layer these unexpected results have been obtained. None of these changes in structure have been disclosed, taught, or suggested by the proposed combination. Further evidence of the state of the art in electron emission density is found in Kusunoki on page 1667 (bottom of left column) wherein the emission current to date (8/20/99 when manuscript received) is 50 x 10^{-6} Amps/cm^2. The desire for at least 1 mA/cm^2 is noted. In Fig. 5, Kusunoki only discloses an emission density of up to this 1mA/cm^2 limit, i.e. the same as Chuman. By annealing the emitter, Applicants have significantly and substantially outperformed other flat tunneling emitters created by prior art techniques thus allowing substitution for less reliable field emission tip emitters.

Claim 36 is believed patentable based at least on the patentability of its parent claim, claim 34.

Claims 37-39 are deemed patentable based at least on the patentability of their parent claim 34.

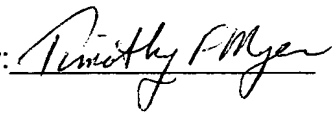
9. Conclusion

The Examiner erred in failing to establish a case of *prima facie* obviousness in rejecting claims 1-17 and 21-40. Applicants respectfully request reversal of these rejections from the Board of Patent Appeals and Interferences, along with timely issuance of a notice of allowance indicating that claims 1-17, and 21-40 are allowed.

Applicants will defer their decision as to whether or not to request oral argument until after receipt of the Examiner's Answer to this Appeal Brief.

Respectfully Submitted,

Chen, Zhizang, et al.

By: 

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APPENDIX

1. (Previously Amended) An emitter, comprising:

an electron supply;

a cathode layer; and

a tunneling layer disposed between the electron supply and the cathode layer wherein the electron supply, cathode layer, and tunneling layer have been subjected to an annealing process.

2. (Original) The emitter of claim 1 wherein the tunneling layer is a metal cluster dielectric.

3. (Original) The emitter of claim 1 wherein the tunneling layer is a metal cluster dielectric selected from the group consisting of TiO_x, TaO_x, WSiN, $TaAlO_xN_y$, $TaAlO_x$ and AlO_xN_y.

4. (Original) The emitter of claim 1 wherein the cathode layer is selected from the group consisting of platinum, gold, molybdenum, tantalum, iridium, ruthenium, chromium, and alloys thereof.

5. (Original) The emitter of claim 1 operable to provide an emission current of greater than 1×10^{-2} Amps per square centimeter.

6. (Original) The emitter of claim 1 operable to provide an emission current of greater than 1×10^{-1} Amps per square centimeter.

7. (Previously Amended) The emitter of claim 1 operable to provide an emission current of greater than 1×10^{0} Amps per square centimeter.

8. (Original) The emitter of claim 1wherein the tunneling layer has a thickness less than about 500 Angstroms.

9. (Original) The emitter of claim 1 wherein the tunneling layer has a thickness less than about 250 Angstroms.

10. (Original) The emitter of claim 1 wherein the tunneling layer has a thickness less than about 100 Angstroms.

11. (Original) The emitter of claim 1 wherein the tunneling layer has a thickness of about 50 Angstroms.

12. (Original) The emitter of claim 1 wherein the tunneling layer has a thickness within the range of about 50 to about 250 Angstroms.

13. (Original) An integrated circuit, comprising:

a substrate;

the emitter of claim 1 disposed on the substrate; and

circuitry for operating the emitter formed on the substrate with the emitter.

14. (Original) An electronic device, comprising:

the emitter of claim 1 capable of emitting energy; and

an anode structure capable of receiving the emitted energy and generating at least a first effect in response to receiving the emitted energy and a second effect in response to not receiving the emitted energy.

15. (Original) The electronic device of claim 14 wherein the electronic device is a mass storage device and the anode structure is a storage medium, the electronic device further comprising a reading circuit for detecting the effect generated on the anode structure.

16. (Original) The electronic device of claim 14 wherein the electronic device is a display device and the anode structure is a display screen that creates a visible effect in response to receiving the emitted energy.

17. (Original) The electronic device of claim 16 wherein the display screen includes one or more phosphors operable for emitting photons in response to receiving the emitted energy.

Claims 18-20 (Cancelled).

21. (Original) An emitter, comprising:

an electron supply layer;

an insulator layer formed on the electron supply layer and having an opening defined within;

a tunneling layer formed on the electron supply layer in the opening; and

a cathode layer formed on the tunneling layer;

wherein the emitter has been subjected to an annealing process to increase the supply of electrons tunneled from the electron supply layer to the cathode layer for energy emission.

22. (Original) The emitter of claim 21 capable of emitting photons in addition to the electron emission.

23. (Original) The emitter of claim 21 wherein the tunneling layer is a metal cluster dielectric.

24. (Original) The emitter of claim 21 wherein the cathode layer has an emission rate greater than about 0.01 Amps per square centimeter.

25. (Original) The emitter of claim 21 wherein the tunneling layer is a metal cluster dielectric selected from the group consisting of TiO_x, TaO_x, WSiN, $TaAlO_xN_y$, $TaAlO_x$ and AlO_xN_y.

26. (Original) The emitter of claim 21 wherein the tunneling layer has a thickness less than 500 Angstroms.

27. (Original) The emitter of claim 21 wherein the tunneling layer has a thickness between about 50 Angstroms and about 250 Angstroms.

28. (Original) A display device, comprising:

an integrated circuit including the emitter of claim 21, wherein the emitter emits a visible light source; and

a lens for focusing the visible light source, wherein the lens is coated with a transparent conducting surface to capture electrons emitted from the emitter.

29. (Original) A storage device, comprising:

an integrated circuit including the emitter of claim 21 wherein the emitter creates an electron beam current; and

a storage medium in close proximity to the emitter, the storage medium having a storage area being in one of a plurality of states to represent the information stored in that storage area;

such that:

an effect is generated when the electron beam current bombards the storage area;

the magnitude of the effect depends on the state of the storage area; and

the information stored in the storage area is read by measuring the magnitude of the effect.

30. (Original) An electronic device, comprising:

an integrated circuit including the emitter of claim 21; and

a focusing device for converging the emissions from the emitter.

31. (Original) A computer system, comprising:

a microprocessor;

the electronic device of claim 30 coupled to the microprocessor; and

memory coupled to the microprocessor, the microprocessor operable of executing instructions from the memory to transfer data between the memory and the electronic device.

32. (Original) The computer system of claim 31 wherein the electronic device is a storage device.

33. (Original) The computer system of claim 31 wherein the electronic device is a display device.

34. (Previously Amended) An emitter, comprising:

an electron supply surface;

an insulator layer formed on the electron supply surface and having a first opening defined within;

an adhesion layer disposed on the insulator layer, the adhesion layer defining a second opening aligned with the first opening;

a conductive layer disposed on adhesion layer and defining a third opening aligned with the first and second openings;

a tunneling layer formed on the electron supply layer within the first, second, and third openings; and

a cathode layer disposed on the tunneling layer and portions of the conductive layer, wherein the portion of the cathode layer on the tunneling layer is an electron-emitting surface wherein the emitter has been subjected to an annealing process.

35. (Original) The emitter of claim 34 wherein the electron emitting surface has an emission rate of about 0.1 to about 1.0 Amps per square centimeter.

36. (Original) The emitter of claim 34, wherein the tunneling layer is a metal cluster dielectric film from the group consisting of TaO_x, WSiN, TiO_x, $TaAlO_xN_y$, $TaAlO_x$, and AlO_xN_y.

37. (Original) The emitter of claim 34, wherein the tunneling layer has a thickness between about 50 Angstroms to about 250 Angstroms.

38. (Original) The emitter of claim 34, wherein the tunneling layer has a thickness of about 100 Angstroms.

39. (Original) The emitter of claim 34, wherein the tunneling layer has a thickness less than about 500 Angstroms.

40. (Original) The emitter of claim 34 wherein the electron-emitting surface also emits photon energy.

Claims 41-71 (Cancelled).